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DEPARTMENT OF HERPETOLOGY

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BULLETIN OF THE MARYLAND HERPETOLOGICAL SOCIETY

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CONTENTS

Notes on Reproduction of the Oceanic Gecko, *Gehyra oceanica* (Squamata: Gekkonidae) from Oceania

Stephen R. Goldberg 1

Adult Body Sizes and Fecundity of the Spring Peeper, *Pseudacris crucifer* (Wied-Neuwied, 1838), from Agricultural Fields in South-Central Pennsylvania

Walter E. Meshaka, Jr., Eugene Wingert, and Maritza A. Morales................5

Preliminary Note on the Amphibians and Reptiles of the Severn Run Natural Environmental Area, Anne Arundel County, Maryland

Herbert S. Harris, Jr.. 9

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BULLETIN OF THE
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Volume 51 Numbers 1-4 January-December 2015

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Notes on Reproduction of the Oceanic Gecko, *Gehyra oceanica* (Squamata: Gekkonidae) from Oceania

Abstract

Data from a histological examination of gonadal material from 45 museum specimens of *Gehyra oceanica* from American Sámoa, Western Samoa, Guam, Society Islands (Moorea), is presented. Males were reproductively active (spermiogenesis) in all months examined (January, April, May, June). The smallest reproductively active male (spermiogenesis) measured 52 mm SVL and was from American Samoa. Mean clutch size (n = 4) was 2.5 ± 0.58 SD, range = 2–3. Females were reproductively active in January and April. The smallest reproductively active female (yolk deposition) measured 53 mm SVL and was from American Samoa. Six adult females from Guam collected April-May exhibited no reproductive activity which contrasts with reproductively active *G. oceanica* females collected in April from the Society Islands (Moorea). Two neonates, collected in April, measured 12 mm (from Guam) and 14 mm SVL from the Society Islands (Moorea), respectively.

The oceanic gecko, *Gehyra oceanica* occurs in New Guinea and most island groups in Melanesia, Micronesia and Polynesia (Bauer, 1994). There is anecdotal information on its reproduction, including reports of clutches of one to two eggs and communal egg laying (Sabath, 1981; Zug, 1991, 2013; McCoy, 2006; Morrison, 2003). Schwaner (1980) reported clutches of 1–4 eggs for *G. oceanica* from American Samoa. In this note I provide additional information on reproduction of *G. oceanica* from American and western Samoa, Society Islands (Moorea), and Guam. *Gehyra oceanica* is currently rare on Guam due to predation on it by the brown tree snake, *Boiga irregularis* (Rodda and Fritts, 1992).

I examined 45 *G. oceanica* deposited in the herpetology collection of the Natural History Museum of Los Angeles County (LACM), Los Angeles, California, USA. The sample was from American Samoa (N = 14),Western Samoa (N = 6), Guam (N = 7), and Society Islands (Moorea) (N = 18). The sample from American Samoa consisted of 9 males (mean Snout vent length, SVL = 71.3 mm ± 10.1 SD, range = 52–83 mm), 4 females (mean SVL = 67 mm ± 11.4 SD, range = 53–80 mm) and one subadult (SVL = 45 mm); the sample from Western Samoa consisted of one male (SVL = 75 mm), one female (SVL = 78 mm) and four subadults (SVL = 27.8 mm ± 8.0 SD, range = 20–38 mm); the sample from Guam consisted of six females (mean SVL = 71.8 mm ± 3.9 SD, range = 67–78 mm) and one neonate (SVL = 12 mm); the sample from the Society Islands (Moorea) consisted of four males (mean SVL = 68.8 mm ± 3.2 SD, range = 64–71 mm), seven females (mean SVL = 66.0 mm ± 3.1 SD, range = 61–69 mm), six subadults (mean SVL = 38.8 mm ± 7.6 SD, range = 31–50 mm) and one neonate (SVL = 14 mm). *Gehyra oceanica* were collected 1975, 1977, 1980, 1989, and 1992. Museum accession numbers (LACM) are in the appendix.

The left gonad was removed from each specimen (except for enlarged follicles or oviductal eggs) and embedded in paraffin. Histological sections were cut at 5 μm and stained by Harris hematoxylin followed by eosin counterstain (Presnell and Schreibman, 1997). Slides were examined to determine the stage of the testicular cycle or the presence of yolk deposition. Oviductal eggs or enlarged ovarian follicles (> 5 mm) were counted but were not histologically examined. Histology slides are deposited in LACM.

Two stages were present in the monthly testicular cycle (Table 1): (1) recrudescence, in which there is a renewal of germinal epithelium for the upcoming period of sperm formation (= spermiogenesis) and (2) spermiogenesis (sperm formation), in which seminiferous tubules are lined by sperm or metamorphosing spermatids. The smallest reproductively active male (spermiogenesis) measured 52 mm SVL (LACM 138560) and was collected in American Samoa during January. One male *G. oceanica* (LACM 141027, SVL = 64 mm) collected in April from the Society Islands (Moorea) exhibited late recrudescence in which small numbers of sperm were present in only a few seminiferous tubules. It is not known when full spermiogenesis (sperm in all seminiferous tubules) would have commenced in this male. It clearly was an adult because it was 12 mm larger than the smallest *G. oceanica* to undergo spermiogenesis (52 mm). My samples are too small to consider the possibility of a resting stage (regression) and recovery (recrudescence) in the yearly testicular cycle of *G. oceanica*.

Table 1. Monthly stages in the testicular cycle of 14 adult *G. oceanica* males from the *Society Islands (Moorea), **American Samoa, *** Western Samoa.

Month	N	Late recrudescence	Full spermiogenesis
**January	8	0	8
*April	4	1	3
** May	1	0	1
***June	1	0	1

Four stages were present in the ovarian cycle (Table 2): (1) quiescent (no yolk deposition); (2) early yolk deposition (basophilic yolk granules in ooplasm); (3) enlarged ovarian follicles (> 5 mm); (4) oviductal eggs. Mean clutch size (N = 4) was 2.5 ± 0.58 SD, range = 2–3. The smallest reproductively active female (yolk deposition) measured 53 mm SVL and was collected in January. Two clutches were from American Samoa, one from western Samoa and one from Society Islands (Moorea). Zug (2013) reported *G. oceanica* likely lay eggs year-round; communal egg laying is common (Gibbons and Zug, 1987; Zug, 1991, 2013; Morrison, 2003; McCoy, 2006). Two neonates were from the Society Islands (Moorea) (SVL = 14 mm, LACM 141024) and Guam (SVL = 12 mm, LACM 141030), both were collected in April.

The lack of reproductive activity in six adult April-May females of *G. oceanica* collected in Guam in 1977 (N = 5) and 1980 (N =1) (Table 2) was unexpected as April females (3/7 43%) from the Society Islands were reproductively active. Might this lack of reproductive activity in *G. oceanica* females from Guam be associated with lack or scarcity of males due to predation by *B. irregularis* which was introduced on Guam in the 1940's and 1950's (Savidge, 1988; Rodda and Fritts, 1992)? Examination of additional *G. oceanica* from museum collections are needed to answer this question.

Acknowledgment

I thank C. Thacker (LACM) for permission to examine *G. oceanica*.

Table 2. Monthly stages in the ovarian cycle of 18 adult *G. oceanica* females from the Society Islands (Moorea), Guam, American Samoa and Western Samoa.

Month	**N**	**Quiescent**	**Early yolk** deposition	**Enlarged follicles >** 5 mm	**Oviductal** eggs
			American Samoa		
January	4	1	1	2	0
			Western Samoa		
January	1	0	0	0	1
			Society Islands (Moorea)		
April	7	4	2	0	1
April	5	5	0	0	0
May	1	1	0	0	0

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Appendix. *Gehyra oceanica* examined from the herpetology collection of the Natural History Museum of Los Angeles County (LACM), Los Angeles, California.

American Samoa LACM 138556–138566; 138568–138570, 147573; Guam 141030, 141326, 141328, 141330, 141332, 141335, 141336; Society Islands (Moorea), LACM 141009, 141010, 141013–1410127, 141029; Western Samoa LACM 119170, 138555, 147565–147568.

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Adult Body Sizes and Fecundity of the Spring Peeper, *Pseudacris crucifer* (Wied-Neuwied, 1838), from Agricultural Fields in South-Central Pennsylvania

Abstract

A series of Spring Peepers from agricultural fields in south-central Pennsylvania was examined to determine adult body sizes, clutch characteristics, and age at sexual maturity. Mean adult body sizes did not significantly differ between males (mean = 25.6 mm) and females (mean = 26.6 mm). Clutch size (mean = 875.8 eggs) co-varied with female body size. Age at sexual maturity ranged from within the first season metamorphosis to nearly two years post-metamorphosis. Results are compared to those of other populations and provide basic ecological data to an otherwise ubiquitous, widespread, yet uncommonly-studied amphibian in Pennsylvania.

Introduction

The Spring Peeper, *Pseudacris crucifer* (Wied-Neuwied, 1838), is an eastern North American hylid, ranging in geographic distribution from south-central Texas and northern Florida northward to southern Manitoba and New Brunswick (Conant and Collins, 1998). Its distribution is statewide in Pennsylvania (Hulse et al., 2001; Meshaka and Collins, 2010). Its ecology has been reviewed by Butterfield et al. (2005) and Dodd (2013). Reproductive studies on this species are few, and in Pennsylvania, fecundity is known only from one study (Meshaka et al., 2012) conducted at a military base in Franklin County in the south-central region of the Commonwealth. In this study, we examined a series of Spring Peepers collected in 2012, 2014, and 2015 from roads bisecting agricultural fields with the goal of comparing the variability in adult body sizes and in clutch characteristics of this species with those from populations elsewhere in its range.

Materials and Methods

Roads bisecting agricultural fields encompassing an area of Walnut Bottom, Cumberland County, Pennsylvania, served as the study site for collections. Individuals were collected from the roads at night, generally in association with humid or wet conditions, during April-November of 2012, 2014, and 2015. Specimens were fixed in formalin and stored in 70% ethyl alcohol and deposited in the collections of the section of Zoology and Botany at the state Museum of Pennsylvania. Snout-vent length was measured to 0.1mm using a hand calipers. Sexual maturity was verified through detection of mature gonads. Clutch size was estimated by weighing on an electronic balance to 0.01 g a subset of 100 eggs from the clutch that was first lightly patted dry. Oval diameter was measured from 10 randomly chosen ova from each clutch using an ocular micrometer to 0.1 mm. Statistics were performed on Excel, and statistical significance was recognized at $p < 0.05$.

Results and Discussion

Mean adult body sizes of males (25.6 ± 1.7 mm SVL; range = 20.9-27.7; n = 29) and females (26.6 ± 2.2 mm SVL; range = 24.3-30.6; n = 11) did not differ significantly from one another ($p = 0.71$); however, the variances of the two samples differed significantly ($F = 0.377$, $df = 33$, $p = 0.001$). Females were collected during April-June, October, and November (**Figure 1**). All females of those collections were gravid. Clutch size (mean = 875.8 ± 468.5 eggs; range = 483.3-2150; n = 11) co-varied significantly ($p=0.003$) with female body size (**Figure 2**). No significant relationship was detected between egg size (mean = 0.92 ± 0.08 mm; range = 0.7-1.1; n = 110) and either female body size ($p = 0.10$) or clutch size ($p = 0.59$).

The distribution of juvenile body sizes in August and September appears to represent more than one cohort produced in a single season, and the body size distributions of males during May-June appeared to represent at least two age-classes (**Figure 1**). Juveniles produced early in the season could have been sexually mature by fall of the same year or, as more likely among females, early the following year. However, the smallest individuals found in August and September would not likely be sexually mature until fall of the next year and breeding for the first time at approximately 20 months after larval transformation (**Figure 1**).

Data from this sample provide a second examination of clutch characteristics of the Spring Peeper form Pennsylvania. At ponds 23.14 km (14.38 miles) southwest of our study site (Meshaka et al., 2012), mean body sizes differed between adult males (mean = 24.5 mm) and females (mean = 28.2 mm), whereas we detected differences in variances only. Mean clutch size of our sample, although larger than that of Meshaka et al. (2012) (mean = 560.3 eggs), was similar with respect to mean egg size (0.91 mm). No relationships among clutch characteristics and female body size or with each other were significant in the Meshaka et al. (2012) study. Adult female body sizes, clutch

Figure 1. Monthly distribution of body sizes of the Spring Peeper, *Pseudacris crucifer*, from agricultural fields in Cumberland County in south-central Pennsylvania, during April-November 2012, 2014, 2015.

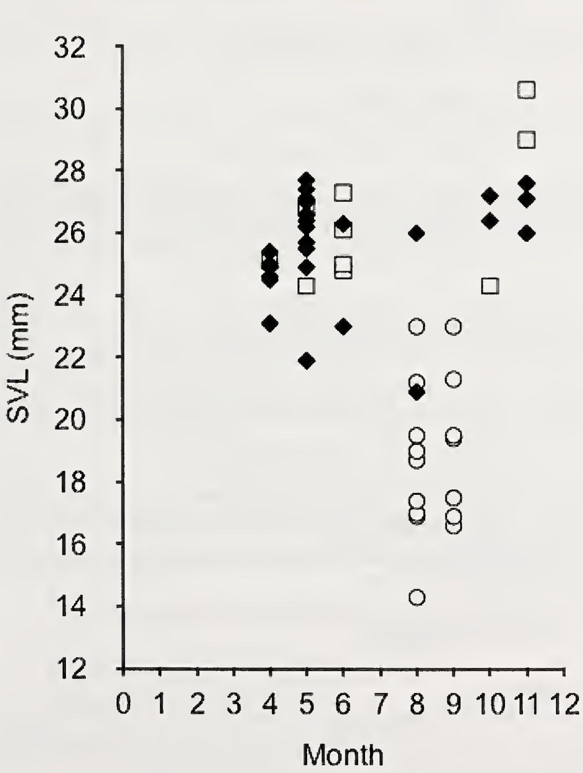
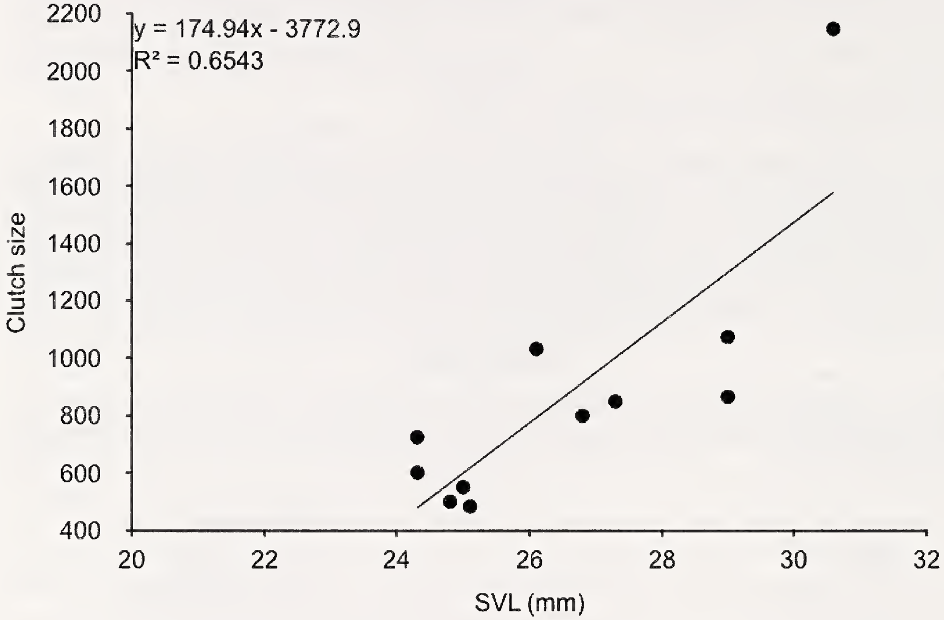


Figure 2. Relationship between clutch size and female body size in the Spring Peeper, Pseudacris crucifer, from agricultural fields in Cumberland County in south-central Pennsylvania.



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characteristics, and relationships among them vary extensively among studies (e.g., Oplinger, 1966 examined in Meshaka et al., 2012; Trauth et al., 1990; Hulse et al., 2001; Meshaka and Marshall, 2011; Mitchell and Pague, 2014)

Sexual maturity can be reached within one (Delzell, 1958) or two (Lykens and Forester, 1987) summers after metamorphosis. Data from our site indicate that both options were possible, the outcomes of which being influenced by date of transformation, metamorphic size, and sex. To that end, the percent of females that did not mature within their first year ranges 36-67% in North Carolina (Alexander, 1966).

Our data contribute to basic life history information of an ubiquitous but scarcely-studied species in Pennsylvania. Our data also underscore the wide range of responses in these life history traits, which could contribute to its broad geographic distribution and potentially to short- and long-term effects associated with climate change.

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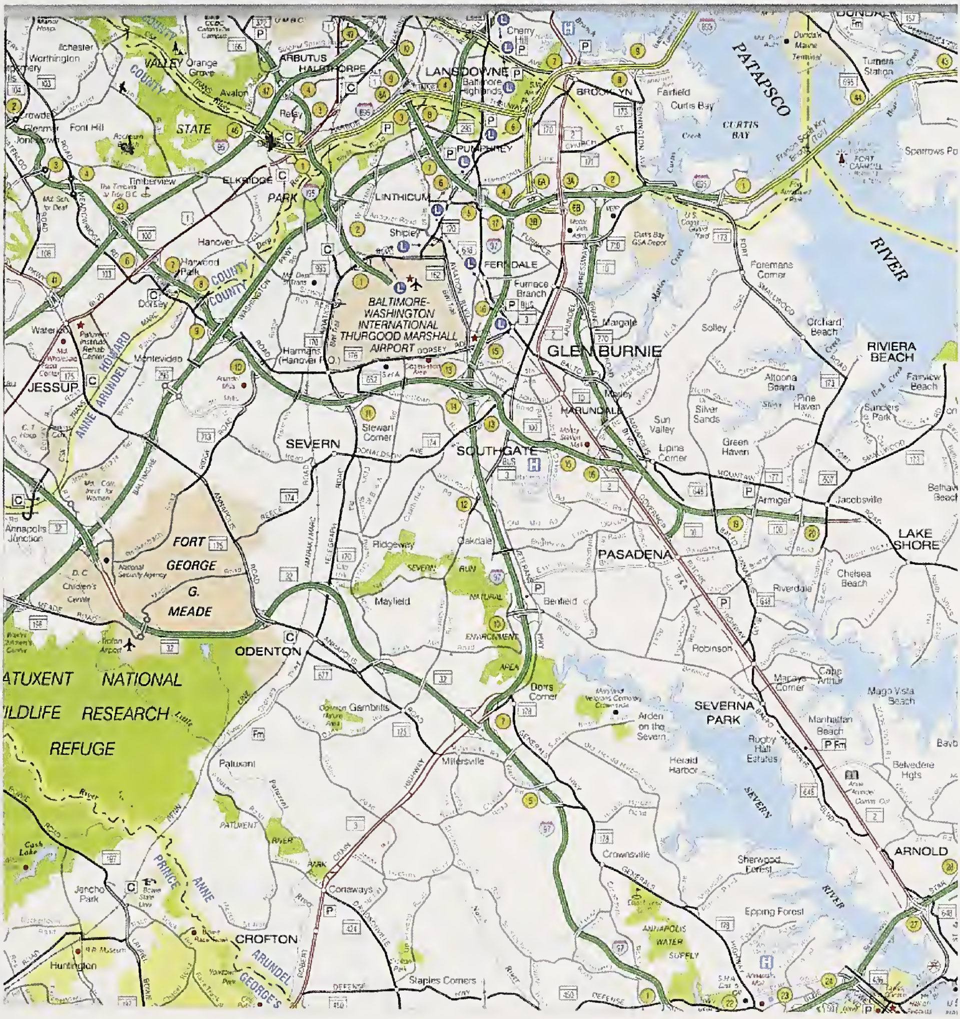
Preliminary Note and Checklist of the Amphibians and Reptiles of the Severn Run Natural Environmental Area, Anne Arundel County, Maryland

The Severn Run Natural Environmental Area (Figure 1., Center), is located in Northern Anne Arundel County, Maryland. It is well known for many rare plant and bird species including the Hartford Fern also called the Climbing Fern, Lygodium palmalum (Bernh.), while uncommon elsewhere, is rather abundant here. My main observations on the amphibians and reptiles have been from road driving both, morning and evening, since 1986. Severn Run itself has been sampled on numerous occasions. The list provided here, also includes the area immediately adjacent, to the Severn Run Natural Environmental Area.

1 (1).	*Anaxyrus americanus americanus*	American Toad
2 (2).	*Anaxyrus fowleri*	Fowler's Toad
3 (3).	*Acris crepitans*	Northern Cricket Frog
4 (4).	*Hyla chrysoscelis*	Cope's Gray Treefrog
5 (5).	*Hyla versicolor*	Eastern Gray Tree frog
6 (6).	*Pseudacris crucifer*	Spring Peeper
7 (7).	*Pseudacris feriarum*	Upland Chorus Frog
8 (8).	*Lithobates catesbeianus*	Bullfrog
9 (9).	*Lithobates clamitans melanotus*	Green Frog
10 (10).	*Lithobates palustris*	Pickerel Frog
11 (11).	*Lithobates sphenocephalus utricularius*	Southern Leopard Frog
12 (12).	*Lithobates sylvaticus*	Wood Frog
13 (13).	*Scaphiopus holbrookii*	Eastern Spadefoot
14 (1).	*Ambystoma maculatum*	Spotted Salamander*
15 (2).	*Ambystoma opacum*	Marbled Salamander*
16 (3).	*Desmognathus fuscus*	Northern Dusky Salamander
17 (4).	*Eurycea bislineata*	Northern Two-lined Salamander
18 (5).	*Hemidactylium scutatum*	Four-toed Salamander
19 (6).	*Plethodon cinereus*	Northern Redback Salamander
20 (7).	*Pseudotriton montanus montanus*	Eastern Mud Salamander
20 (8).	*Pseudotriton ruber ruber*	Northern Red Salamander



21 (9).	*Notophthalmus viridescens viridescens*	Red-spotted Newt
22 (1).	*Chrysemys picta*	Northern Painted Turtle
23 (2).	*Clemmys guttata*	Spotted Turtle
24 (3)	*Glyptemys insculpta*	Wood Turtle**
25 (4)	*Pseudemys rubriventris*	Eastern Redbelly Turtle
26 (5)	*Terrapene carolina carolina*	Eastern Box Turtle
27 (6)	*Trachemys scripta elegans* (feral)	Red-eared Slider

28 (7)	*Kinosteron subrubrum subrubrum*	Eastern Mud Turtle
29 (8)	*Sternotherus odoratus*	Common Musk Turtle
30 (1)	*Sceloporus undulates*	Eastern Fence Lizard
31 (2)	*Plestiodon fasciatus*	Five-lined Skink
32 (3)	*Plestiodon laticeps*	Broadhead Skink
33 (4)	*Scinella lateralis*	Ground Skink
34 (5)	*Aspidoscelis sexlineata sexlineata*	Six-lined Racerunner
35 (1)	*Cemorphora coccinea copei*	Northern Scarlet Snake
36(2)	*Coluber constrictor constrictor*	Northern Black Racer
37 (3)	*Lampropeltis calligaster rhombomaculata*	Mole Kingsnake
38 (4)	*Lampropeltis getula getula*	Eastern Kingsnake
39 (5)	*Lampropeltis triangulum triangulum*	Eastern Milk Snake***
40 (6)	*Opheodrys aestivus*	Rough Green Snake
41 (7)	*Pantherophis guttatus*	Eastern Corn Snake
42 (8)	*Scotophis alleghaniensis*	Eastern Rat Snake
43 (9)	*Agkistrodon contortrix mokasen*	Northern Copperhead
44 (10)	*Carphophis amoenus amoenus*	Eastern Worm Snake
45 (11)	*Diadophis punctatus edwardsii*	Northern Ringneck Snake
46 (12)	*Nerodia sipedon sipedon*	Northern Water Snake
47 (13)	*Regina septemvittata*	Queen Snake
48 (14)	*Storeria dekayi dekayi*	Northern Brown Snake
49 (15)	*Storeria occipitomaculata occiptomaculata*	Northern Redbelly Snake
50 (16)	*Thamnophis sauritus sauritus*	Eastern Ribbon Snake
51 (17)	*Thamnophis sirtalis sirtalis*	Eastern Garter Snake
52 (18)	*Virginia valeriae valeriae*	Eastern Earth Snake
53(19)	*Heterodon platirhinos*	Eastern Hognose Snake

*This species has not been observed, but should occur here *(Ambystoma maculatum* and *A. opacum).*

**The Wood Turtle, although not collected here, has been collected in northern Anne Arundel County. It is normally a Piedmont form, but does occur just south in Maryland in the Coastal Plain.

***The Eastern Milk Snake, this species although uncommon in the Coastal Plain should occur here and would be the the form *L. t. temporalis*.

Note: A possible addition to this checklist could possibly be Hyla cinerea, the Green Tree Frog. At the SE end of the SRNEA, along Pointfield Drive which is on a peninsula that juts out into the Severn River, residents have told me of hearing frogs calling from the reeds and cattails that sound like quacking ducks. If this species can be confirmed we could add this beautiful tree frog to the above list.

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